

## Geodetic Observatory TIGO in Concepción

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### Abstract

In 2010, 119 successful VLBI observations were carried out at TIGO. The present report reviews the 2010 activities, and the forthcoming 2011 tasks are also given.

### 1. General Information

The operation of TIGO is based on an agreement between the Republic of Chile and the Federal Republic of Germany. The operation relies on three institutions:

- Universidad de Concepción (Chile),
- Instituto Geográfico Militar (Chile), and
- Bundesamt für Kartographie und Geodäsie (Germany).

TIGO is located on terrain of the Universidad de Concepción (long. 73.025 degrees West, lat. 36.843 degrees South), in Concepción, Chile.

### 2. Component Description

The IVS Network Station TIGOCONC constitutes the VLBI part of the Geodetic Observatory TIGO, which was designed to be a fundamental station for geodesy. Hence, the VLBI radio telescope is co-located with an SLR telescope (ILRS site), a GPS/Glonass permanent receiver (IGS site), and other instruments such as a seismometer, a superconducting gravimeter, and an absolute gravity meter.

The atomic clock ensemble of TIGO consists of three hydrogen masers, three cesium clocks, and four GPS time receivers realizing the Chilean contribution to the Universal Time scale (Circular T, BIPM).

The technical parameters of the TIGO radio telescope as published in [1] have not changed.

### 3. Staff

The VLBI staff changed in two positions: Miguel Soto and Cristian Duguet left TIGO at the beginning of the year and were replaced by Felipe Pedreros and Octavio Zapata. The 2010 TIGO VLBI group consisted of the persons listed in Table 1.

### 4. Current Status and Activities

During 2010 TIGO was scheduled to participate in 119 IVS experiments (see Table 2) and four 24-hour experiments framed of the TANAMI project [2]. Five additional experiments (TQUAK) had been initiated as soon as TIGOCONC became operational again after the M8.8 earthquake in Concepción on February 27, 2010.

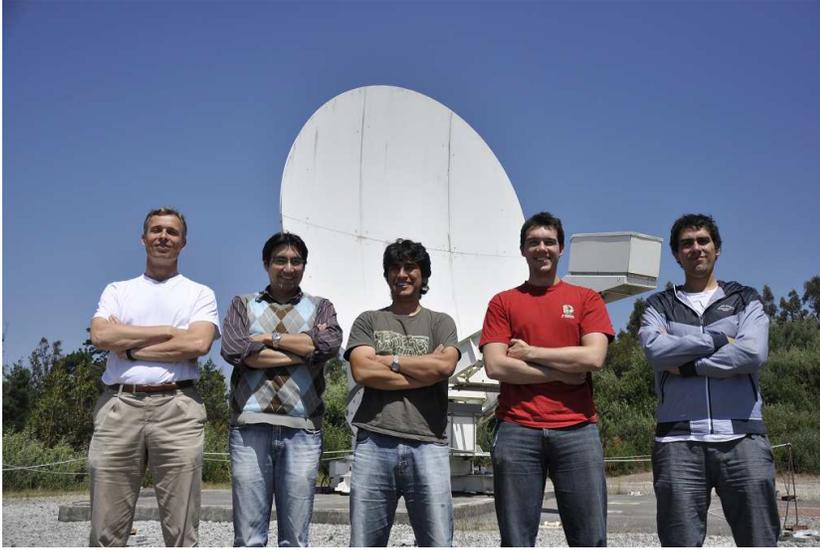


Figure 1. Current VLBI Staff: Hase, Herrera, Sobarzo, Zaror, and Zapata. Oñate and Pedreros were absent.

Table 1. TIGO-VLBI support staff in 2010.

| Staff              | Function                    | Email                    |
|--------------------|-----------------------------|--------------------------|
| Hayo Hase          | Head                        | hayo.hase@tigo.cl        |
| Sergio Sobarzo     | Chief Engineer              | sergio.sobarzo@tigo.cl   |
| Eric Oñate         | Electronic Engineer         | eric.onate@tigo.cl       |
| Cristian Herrera   | Informatic Engineer         | cristian.herrera@tigo.cl |
| Pedro Zaror        | Mechanical Engineer         | pedro.zaror@tigo.cl      |
| Felipe Pedreros    | Telecommunications Engineer | felipe.pedreros@tigo.cl  |
| Octavio Zapata     | Telecommunications Engineer | octavio.zapata@tigo.cl   |
| any VLBI-operator  | on duty                     | vlbi@tigo.cl             |
| all VLBI-operators |                             | vlbistaff@tigo.cl        |

Table 2. TIGO's IVS observation statistics for 2010.

| Name      | # of Exp. | OK  | Failed |
|-----------|-----------|-----|--------|
| R1xxx     | 47        | 41  | 6      |
| R4xxx     | 50        | 46  | 4      |
| R&D       | 4         | 4   | 0      |
| OHIGxx    | 6         | 6   | 0      |
| T20xx     | 7         | 7   | 0      |
| TQAKXX    | 5         | 5   | 0      |
| Tanami    | 4         | 4   | 0      |
| Total IVS | 119       | 109 | 10     |

### 4.1. Post-earthquake Recovery

The M8.8 earthquake destroyed or damaged several instruments and infrastructure of TIGO. All TIGO containers had been shaken heavily and changed their positions. A horizontal displacement of more than 3 meters of the TIGO site was measured by GPS/GLONASS and later on confirmed by independent VLBI and SLR measurements (Fig. 2).

The recovery consisted of a diagnosis plan and damage analysis of the equipment to bring them back to operation as soon as possible. The TIGO team made tests of all components of the VLBI systems including racks, wiring, inclinometers, computers, and the radio telescope.

The mechanical functionality was carefully checked to detect possible damages in the cables chain, motors, and gears, among others by conducting manual movements in azimuth and elevation to avoid problems later on during real measurements.

Thanks to these successful tests, TIGO was able to participate already two weeks after the major event from the R1422 experiment onwards—covering still the period of strong post-seismic motion.

VLBI measurements are shown in Fig. 2 where the earthquake displacement and subsequent behavior can be appreciated.

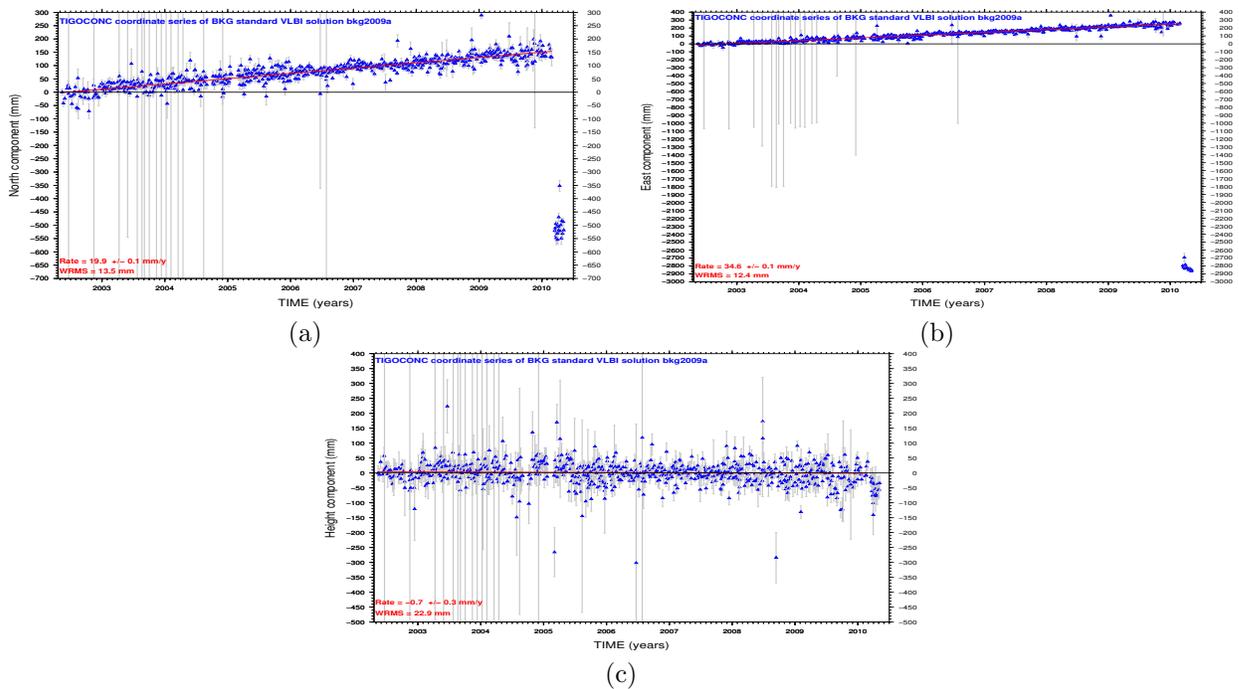


Figure 2. TIGOCONC coordinate time series showing earthquake displacement. a) North component b) East component c) Height component.

### 4.2. Mark 5 Upgrade

In September and October 2010, an upgrade of the Data Acquisition System was performed. This consisted of a complete change of hardware and software of one of the two recording systems, namely from Mark 5A to Mark 5B, and the replacement of one VSI card in the formatter. For the

development of this project, the MIT Haystack Observatory facilitated a Mark IV formatter as backup while the necessary tests and adjustments were performed for the implementation of the new system.

## 5. Future Plans

The VLBI activities in 2011 will be focused on:

- execution of the IVS observation program for 2011
- continuation of investigations related to e-VLBI
- repetition of the local survey.



Figure 3. Earthquake damage, photos taken in Concepción a few days after the quake.

## References

- [1] Vandenberg, N.R.: International VLBI Service for Geodesy and Astrometry 2000 Annual Report, NASA/TP-1999-209243, 1999.
- [2] M. Kadler, R. Ojha, S. Tingay and J. Lovell, *The TANAMI Program: Southern-Hemisphere VLBI Monitoring of Relativistic Jets in Active Galaxies*, American Astronomical Society, AAS Meeting #211, #04.13; Bulletin of the American Astronomical Society, Vol. 39, p.732.